UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/802,141	03/17/2004	Nagesh Sonti	215P011709-US (PAR)	3267

2512 7590 02/27/2007

PERMAN & GREEN
425 POST ROAD
FAIRFIELD, CT 06824

EXAMINER	
KESSLER, CHRISTOPHER S	
ART UNIT	**PAPER NUMBER**
1742	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/27/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/802,141	SONTI ET AL.	
	Examiner	Art Unit	
	Christopher Kessler	1742	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 March 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-46* is/are pending in the application.

4a) Of the above claim(s) *1-18,33,34,36 and 40* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *19-32,35,37-39 and 41-46* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☒ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☑ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date 17 MARCH 2004
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Claims 1-18, 33, 34, 36, 40 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on 26 January 2007. Claims 19-32, 35, 37-39 and 41-46 are currently under examination.

Oath/Declaration

2. The oath or declaration is defective. A new oath or declaration in compliance with 37 CFR 1.67(a) identifying this application by application number and filing date is required. See MPEP §§ 602.01 and 602.02.

The oath or declaration is defective because:
It does not identify the citizenship of each inventor.

Examiner's Interpretation

3. The Examiner notes that claims 19-32, 35, and 37-39 are drawn to a method of ausforming a gear formed by powder metallurgy. Claims 41-46 appear to be drawn to a distinct invention, bearing a different classification. In order to expedite prosecution of the instant application, it is assumed that the workpieces of claims 41 and 43 are formed by powder metallurgy. Such an assumption is supported by the title and

disclosure of the instant application; however, Applicant is directed to MPEP §2111.01 II. Applicant is advised that in future Office Actions, any claim that appears to be drawn to a distinct invention will be subject to a requirement for restriction, including claims 41-46.

Double Patenting

4. Applicant is advised that should claim 21 be found allowable, claim 27 will be objected to under 37 CFR 1.75 as being a substantial duplicate thereof. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

Claim Rejections - 35 USC § 112

5. Claims 31 and 32 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. There is no mention in the instant specification or in the dopcuments incorporated by reference wherein the process is used to fabricate an intersecting axis gear of claim 31 or a worm gear of claim 32.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 19-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent 5,451,275 issued to Amateau et al. (hereinafter "Amateau"), in view of U. S. Patent 5,711,187 issued to Cole et al. (hereinafter "Cole").

Regarding claim 19, Amateau describes the invention substantially as claimed. Amateau describes a method comprising the steps of

> (a) heating a metal workpiece in the form of a near net shaped gear blank having gear teeth surfaces above its critical temperature to obtain an austenitic structure throughout its surfaces;

(b) isothermally quenching the workpiece at a rate greater than the critical cooling rate of its surfaces to a uniform metastable austenitic temperature just above the martensitic transformation temperature;

(c) rolling the gear teeth surfaces of the workpiece to a desired outer peripheral profiled shape between opposed dies, each die having an outer peripheral profiled surface, while holding the workpiece at the uniform metastable austenitic temperature. the gear teeth surfaces undergoing densification. plastic deformation and strengthening as a result of the rolling operation; and

(d) cooling the workpiece through the martensitic range to thereby harden the surfaces of the gear teeth.

More specifically, in claim 1, Amateau describes;

(b) heating a workpiece in the form of a near net shaped gear blank having carburized gear teeth surfaces above its critical temperature to obtain an austenitic structure throughout its carburized surfaces;
(c) isothermally quenching the gear blank at a rate greater than the critical cooling rate of its carburized surfaces to a uniform metastable austenitic temperature just above the martensitic transformation temperature;
(d) holding the temperature of the gear blank at said uniform temperature while rolling the gear teeth surfaces between a pair of diametrically opposed rolling gear dies to a desired shape before martensitic transformation occurs; and
(e) cooling the gear through the martensitic range for the carburized gear surfaces to harden the gear surfaces.

Amateau does not disclose wherein the workpiece is a powder metal workpiece.

Cole teaches that a near net shaped gear blank is formed from a metal powder, and subsequently worked using a rolling machine to form a gear wheel for a power transmission (see col. 1, line 8-col. 2, line 65). It would have been obvious to one of ordinary skill in the art at time of invention to substitute a powder metal gear blank as taught by Cole for the hobbed gear blank disclosed in Amateau, in order to tailor the

steel composition to particular applications, as taught by Cole (see col. 1, line 63-col. 2, line 41).

Regarding claim 20, additional steps (e) and (f) claimed by applicant would be inherent in step (d) of Amateau shown above, if that step were performed as stated above on a powder metal gear blank (see MPEP §2112). Compaction under high temperature (hot working) is well established in the art to cause pores of a sintered PM workpiece to collapse and to cause the workpiece to plastically deform.

Regarding claim 21, Amateau is applied to the claim as stated above. Cole discloses wherein the powder metal workpiece is pressed and sintered prior to rolling (see abstract).

Regarding claim 22, Amateau and Cole are applied to the claim as stated above. Densification is well known in the art to be the primary goal of sintering operations, and is thus an inherent part of sintering (see MPEP §2112).

Regarding claim 23, Cole discloses wherein the powder metal workpiece is pressed and sintered prior to rolling (see abstract), meeting the definition of single pressing the workpiece.

Regarding claim 24, Cole discloses wherein the powder metal workpiece is pressed and sintered prior to rolling (see abstract), meeting the definition of single sintering the workpiece.

Regarding claim 27, Amateau is applied to the claim as stated above. Cole discloses wherein the powder metal workpiece is pressed and sintered prior to rolling (see abstract).

Regarding claim 28, Amateau is applied to the claim as stated above. Cole discloses wherein the powder metal gear blank is rolled such that the tooth and flank regions have a density in the range of 90 to 100 percent of full theoretical density at a depth of 380 microns and up to 500 microns (see col. 1, lines 36-62), said depth range falling within the broader range claimed by applicant and establishing a prima facie case of obviousness for that range (see MPEP §2144.05).

Regarding claim 29, Amateau discloses fabricating a parallel axis gear (see col. 2, lines 9-44).

Regarding claim 30, Amateau discloses fabricating helical gears and spur gears (see col. 2, lines 9-44).

7. Claims 25 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Amateau in view of Cole as applied to claim 21 above, and further in view of Applicant's Admitted Prior Art.

Regarding claim 25, it is well known in the art to combine sintering and hardening operations into an integrated operation. It is well known in the art to introduce a hardening or carburizing atmosphere during sintering. For example, Applicant has shown "atmospheric sintering" in Fig. 6 of the instant specification, which is directed to

prior art powder metallurgy processes. It would thus be obvious to one of ordinary skill in the art to use an integrated sintering and hardening operation during atmospheric sintering in order to save time and money in processing.

Regarding claim 26, it is well known in the art to combine sintering, hardening and carburizing operations into an integrated operation. It is well known in the art to introduce a hardening or carburizing atmosphere during sintering. For example, Applicant has shown "atmospheric sintering" in Fig. 6 of the instant specification, which is directed to prior art powder metallurgy processes. It would thus be obvious to one of ordinary skill in the art to use an integrated sintering, carburizing and hardening operation during atmospheric sintering in order to save time and money in processing.

8. Claims 35, 37-39 and 41-46 are rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent 6,779,270 issued to Sonti et al. (hereinafter "Sonti"), in view of Cole.

Regarding claim 35, Sonti teaches the invention substantially as claimed. Sonti teaches in claim 1,

1. A method of producing a full form net shape roll finished contacting machine element from a near net shape workpiece of wrought or forged steel having an initial outer peripheral contoured surface and including a plurality of teeth, each having a tooth flank with a nominally involute surface and a root/fillet region with a trochoidal surface, the method comprising the steps of:

rotatably supporting on a first axis a rolling die having an outer peripheral contoured surface extending between generally parallel spaced lateral surfaces transverse to the first axis, the rolling die including a plurality of teeth, each including a tooth flank with opposed involute surfaces and a tooth tip surface;

rotatably supporting the workpiece on a second axis distant from and parallel to the first axis;

advancing the rolling die in an in-feed direction generally perpendicular to the first and second axes such that the rolling die meshingly engages with the workpiece,

rotating the rolling die about the first axis while engaged with the workpiece;

while performing step (d), maintaining continuous conjugacy between the rolling die and the workpiece with the involute surface of each tooth of the rolling die engaging the involute surface of a mating tooth of the workpiece and the tooth tip of the rolling die engaging the trochoidal root/fillet surface between adjacent mating teeth of the workpiece to effect material flow along the outer peripheral contoured surface;

continuing to advance the rolling die in the in-feed direction thereby deforming the surface of each tooth flank and of a corresponding root/fillet region until a final net shape of each tooth and root/fillet region is achieved, and

continuing to perform all of the preceding steps with the rolling die and workpiece meshingly engaged, thereby deforming the involute and trochoidal root/fillet surfaces of all of the teeth of the workpiece resulting in a final net shaped machine element.

Sonti does not teach wherein the workpiece is a powder metal workpiece, or

(e) rolling the gear teeth surfaces of the workpiece to a desired outer peripheral profiled shape while engaged with the rolling die having an outer peripheral profiled surface while holding the workpiece at the uniform metastable austenitic temperature the gear teeth surfaces undergoing densification, plastic deformation, and strengthening as a result of the rolling and sliding operation.

Cole teaches that a near net shaped gear blank is formed from a metal powder, and subsequently worked using a rolling machine to form a gear wheel for a power transmission (see col. 1, line 8-col. 2, line 65). It would have been obvious to one of ordinary skill in the art at time of invention to substitute a powder metal gear blank as taught by Cole for the forged gear blank disclosed in Sonti, in order to tailor the steel composition to particular applications, as taught by Cole (see col. 1, line 63-col. 2, line 41).

The limitation of the gear teeth surfaces undergoing densification, plastic deformation, and strengthening as a result of the rolling and sliding operation. Would be inherent in the process of Sonti shown above, if that step were performed as stated above on a powder metal gear blank (see MPEP §2112). Compaction under high temperature (hot working) is well established in the art to cause pores of a sintered PM workpiece to collapse and to cause the workpiece to plastically deform. The closing of pores is further known to cause strengthening in powder metal workpieces.

Regarding claim 37, additional steps (i) and (j) claimed by applicant would be inherent in the process of Sonti shown above, if that step were performed as stated above on a powder metal gear blank (see MPEP §2112). Compaction under high temperature (hot working) is well established in the art to cause pores of a sintered PM workpiece to collapse and to cause the workpiece to plastically deform.

Regarding claim 38, Sonti further discloses a process in claim 2:

> 2. A method as set forth in claim 1 including the step, before step (c) of:
>
> advancing the workpiece in a through-feed direction parallel to the first and second axes such that the outer peripheral contoured surface of the workpiece engages the outer peripheral contoured surface of the rolling die and continues to advance until the workpiece is positioned substantially coextensive with the rolling die in the through-feed direction.

Regarding claim 39, Sonti further discloses a process in claim 3:

> 3. A method as set forth in claim 2 wherein step (c) includes the steps of:
>
> simultaneously with step (g) after the workpiece and rolling die are substantially enmeshed, advancing the rolling die within a plane containing the first and second axes, in an in-feed direction substantially perpendicular to the first and second axes until the outer peripheral contoured surface of the rolling die engages the outer peripheral contoured surface of the workpiece at a near net shaped center distance establishing an initial center distance between the first and second axes when the workpiece and the rolling gear die are initially engaged; and
>
> continuing to advance the workpiece in the in-feed direction by an additional increment of center distance thereby deforming the profile surfaces of each tooth resulting in final net shape of the teeth.

Regarding claim 41, Applicant has stated in the specification, pages 22-23, that the difference between the technique as claimed for making the rolling dies and conventional techniques known in the art of making rolling dies is that "the die tooth profile maintains conjugacy in the root/fillet area of the gear tooth in addition to the area of active contact" (p. 22). Sonti teaches "in order to maintain a constant anguar velocity, it is therefore necessary to produce on the rolling dies a tooth profile which is conjugate to the finished gear during all phases of the engagement" (see col. 6, lines 55-59). Sonti further discloses steps (a)-(h) of claim 41 (see col. 6, line 24- col. 8, line 12).

As for steps (i)-(p) of claim 41, Sonti and Cole are applied to the claim as stated in the claim rejections above.

Regarding claim 42, additional steps (q) and (r) claimed by applicant would be inherent in the process of Sonti shown above, if that step were performed as stated above on a powder metal gear blank (see MPEP §2112). Compaction under high temperature (hot working) is well established in the art to cause pores of a sintered PM workpiece to collapse and to cause the workpiece to plastically deform.

Regarding claim 43, Sonti teaches the invention substantially as claimed in claim 6:

6. A method of producing a full form net shape roll finished contacting machine element from a near net shape workpiece of wrought or forged steel having an initial outer peripheral contoured surface and including a plurality of teeth, each having a tooth flank with a nominally involute surface and a root/fillet region with a trochoidal surface, the method comprising the steps of:

rotatably supporting on first and second generally parallel spaced axes, first and second rolling dies, each having an outer peripheral contoured surface extending between generally parallel spaced lateral surfaces transverse to the first axis, each rolling die including a plurality of teeth, each tooth including a tooth flank with opposed involute surf aces and a tooth tip surface;

rotatably supporting the workpiece on a third axis distant from and parallel to the first and second axes;

advancing the first and second rolling dies, within a common plane generally containing the first, second, and third axes in respectively opposite in-feed directions generally perpendicular to the third axis until the rolling die meshingly engages with the workpiece,

rotating the rolling dies at a constant angular velocity about their associated first and second axes while engaged with the workpiece;

while performing step (d), maintaining continuous conjugacy between each of the rolling dies and the workpiece with the involute surface of each tooth of each of

> the rolling dies engaging the involute surface of a mating tooth of the workpiece and the tooth tip of each of the rolling dies engaging the trochoidal root/fillet surface between adjacent mating teeth of the workpiece to effect material flow along the outer peripheral contoured surface;
>
> continuing to advance each of the rolling dies in the in-feed direction thereby deforming the surface of each tooth flank and of a corresponding root/fillet region until a final net shape of each tooth and of each root/fillet region is achieved, and
>
> continuing to perform all of the preceding steps with the rolling dies and workpiece meshingly engaged, thereby deforming the involute and trochoidal root/fillet surfaces of all of the teeth of the workpiece resulting in a final net shaped machine element.

Cole is applied to the claim as stated above.

Regarding claim 44, additional steps (i) and (j) claimed by applicant would be inherent in the process of Sonti shown above, if that step were performed as stated above on a powder metal gear blank (see MPEP §2112). Compaction under high temperature (hot working) is well established in the art to cause pores of a sintered PM workpiece to collapse and to cause the workpiece to plastically deform.

Regarding claim 45, Sonti further discloses in claim 7:

> 7. A method as set forth in claim 6 including the step, before step (c) of:
>
> advancing the workpiece in a through-feed direction parallel to the first, second, and third axes such that the outer peripheral contoured surface of the workpiece engages the outer peripheral contoured surface of each of the rolling dies and continues to advance until the workpiece is positioned substantially coextensive with the rolling dies in the through-feed direction.

Cole is applied to the claim as stated in rejections above.

Regarding claim 46, Sonti further discloses in claim 8:

8. A method as set forth in claim 7 wherein step (c) includes the steps of:

simultaneously with step (g) after the workpiece and rolling die are substantially enmeshed, advancing the rolling die within a plane containing the first and second axes, in an in-feed direction substantially perpendicular to the first and second axes, until the outer peripheral contoured surface of the rolling die engages the outer peripheral contoured surface of the workpiece at a near net shaped center distance establishing an initial center distance between the first and second axes when the workpiece and the rolling gear die are initially engaged; and

continuing to advance the workpiece in the in-feed direction by an additional increment of center distance thereby deforming the profile surfaces of each tooth resulting in final net shape of the teeth.

Cole is applied to the claim as stated in rejections above.

Conclusion

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christopher Kessler whose telephone number is (571) 272-6510. The examiner can normally be reached on Mon-Fri, 9-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Roy King can be reached on (571) 272-1244. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

csk